Kinetics of Carbonyl Sulfide Hydrolysis in Propane and Light n-Alkanes

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Carbonyl sulfide (COS), which occurs as an impurity in commercial sources of propane, can hydrolyze in the presence of water to form hydrogen sulfide (H_2S) and carbon dioxide. While COS is not itself corrosive, the hydrolysis product H_2S is corrosive, especially in the presence of water. This corrosivity is reflected in the failure of the ASTM D-1838 copper strip corrosion test, and is thought to be a major problem in the liquefied petroleum gas industry. In this study, measurements of COS hydrolysis kinetics in propane were made from 16 to 85 °C. Additional hydrolysis measurements were made in systems containing methane, ethane, n-butane, and n-hexane. Reaction rates were determined from gas chromatographic monitoring of the decrease in COS and the appearance of H_2S in the vapor phase as a function of time. The hydrolysis rates varied for each of the hydrocarbon systems and all rates were several orders of magnitude slower than what has been previously reported for pure water. These observations suggest COS hydrolysis is not responsible for propane failure by the copper strip corrosion test. Furthermore, we found the rate of COS hydrolysis to be correlated with the binary interaction diffusion coefficient, D_{12}, for the alkanes in water. This suggests that the diffusion of larger organic molecules into the aqueous phase impedes the ability of COS to react with water.